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ABSTRACT

This paper describes Learning Link, a pilot project interactive communications system which provides support materials for the instructional television program of WNET/Thirteen, the New York Metropolitan area public television station. Features of the system are described, including databases, bulletin-board-like conferences, information libraries, and electronic mail, and it is suggested that Learning Link provides a potential model for effective and cost efficient servicing of precollege educational institutions on a regional basis. Some of the experiences and problems encountered in the system's development and operation are discussed, particularly those with broader implications for organizations interested in using technology to improve access to educational resources. (EW)

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Learning Link

A Model for Low-Cost Educational Networks

Robert A. Spielvogel

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Introduction

The Learning Link interactive communications system, in operation at WNET/Thirteen since October 1985, provides a potential model for effective and cost-efficient servicing of precollege educational institutions on a regional basis.

This paper describes the current Learning Link system and discusses some of the experiences and problems encountered in its development and operation, particularly those with broader implications for organizations interested in using technology to improve access to educational resources.

Learning Link: A Model for Low-Cost Educational Networks

Learning Link is a computer-based network operated by WNET/Thirteen, the public television station that serves the metropolitan New York area. The system is a test-only interactive multiuser service that features data bases, bulletin-board-like conferences, information libraries, and electronic mail. It provides support for educators, mostly at the elementary and secondary school level, who utilize learning technologies such as television, video, microcomputers, videodisc, and on-line data bases as instructional tools.

After operating the system at WNET for nearly two years, we can share some experiences and observations that may be relevant to others interested in educational applications of telecommunications.

We are now at the stage where we can offer the system to other public television stations and education agencies. Each site will be an independent system adapted to local differences and needs. Together, the sites will form a network of independently operated systems to benefit from some central support and cost sharing. These issues also are explored here.

First, however, some explanation is needed as to why the nation's largest public broadcaster and producer of much of the programming found on public television stations around the country is operating a computer network.

Two years ago, WNET/Thirteen conducted an assessment of how the station could improve its support services for K–12 schools. WNET had operated a traditional ITV service consisting of broadcasts of instructional television programming designed specifically for classroom use, along with print schedules, lesson plans packaged into teacher guides for each series, and utilization workshops for teachers.

However, there were never enough education personnel to do direct outreach and training for schools—a problem that is especially acute at stations that broadcast in major urban areas. Within our service area there are just too many schools to reach on a direct basis. Fiscal realities make it unlikely that the educational outreach staff involved in providing these traditional services will be expanded significantly.

Ironically, utilization of public television programming and the need for support services are increasing. The arrival of videocassette recorders and microcomputers in large numbers has changed the information needs of schools dramatically. The VCR, available in more than 50 percent of all schools, allows teachers to use educational programming in a far more flexible manner—teachers are no longer tied to the broadcast schedule or limited to utilizing just the instructional television programs.

Teachers now request information on all of the programming aired: prime time science series such as *Nature*, *NOVA*, or *Planet Earth*, and cultural series created for specific in-class use. And they need more specific information than that found in the local newspaper or *TV Guide*. They want to know what a program is about in terms that are relevant to their instructional needs, what ancillary materials or experiences can be tied into it, exactly when to tape it, and what their legal rights and responsibilities are when taping a particular program.

We have found that print support materials alone can't handle, in any cost-efficient manner, the volume of information that needs to be available to teachers if they are to utilize the educational resources found on public television. Print support materials are increasingly inadequate as the sole means of disseminating information.

Another finding of our assessment was a growing need to position educational television within a context of learning technologies in general. Educators want to integrate video, computers, and data bases into complementary resources that work directly with their teaching, not as unconnected peripheral experiences. Treating television as a separate, isolated resource does not meet the needs of media coordinators, librarians, and classroom teachers who deal with a wide range of technologies, media, and programming sources.

Our conclusion was that while television, video, computers, and other learning technologies obviously offer notable opportunities for delivering educational resources to students, the key to realizing this potential lies in helping teachers locate and make effective use of high-quality programming that fits into their existing curriculum content or allows them to expand curriculum where appropriate. We decided to develop information services and information manipulation tools that place our programming in the context of the school curriculum and in conjunction with other learning technologies.

After reviewing service options including single-line bulletin boards, conferencing utilities like New Jersey Institute of Technology's EIES system, national on-line services such as CompuServe or The Source, and even using the vertical blanking interval or second channel stereo subcarrier of our broadcast signal for data downloading, teletext, or videotex, we formulated the set of assumptions that has guided the development of Learning Link.

Assumptions Behind Learning Link

The system must permit frequent change and modification. We needed a flexible set of tools during the startup phase. Our goal was to mount a basic service and then work with our users to refine and extend it. Since there were few successful projects to guide Learning Link's development, trial-and-error based, iterative design seemed the best strategy. We wanted a system that could be developed in a modular fashion based on feedback from schools using the service.

The system should run on off-the-shelf equipment and build on existing software to keep the initial funding requirements as low as possible. Requiring significant financial commitment to capital costs would limit our ability to replicate the system at other sites even if we were to obtain grants or underwriting support for a pilot.

The service needs to support growth and expansion. While our target market was 500 schools, we wanted to ensure that the system could handle significant expansion without forcing users to abandon their investment in hardware and software.

The system should present few barriers to school use. That meant requiring no specialized equipment or software that is unique to this service. The system should be accessible from equipment already installed in schools. Usage of the system should be on a float-rate basis; schools have difficulty with open-ended on-line charges or usage-sensitive billing.

The system should permit simultaneous access by several users and by system operators. Teachers are too busy to try again if the information is already in use or is blocked for updating.

The system should be accessible by a wide range of educators with varying degrees of technical sophistication. And it should be easy to operate, for the users and for us; our limited budget would not support specialized staff or extensive training.

Learning Link at WNET/Thirteen

For several reasons, we chose telephone-based microcomputer communications as the basis for the system. Schools now have microcomputers in significant numbers and often in several locations within a building. The interest in educational applications of telecommunications has resulted in a growing number of modems in schools, but beyond local bulletin boards, relatively few inexpensive services exist to support their use. The same software and hardware necessary to access Learning Link can be used to access other services.

The service was publicly launched in October 1985 and has since run 24 hours a day, seven days a week with no major technical problems and only minor service disruptions. We do not charge schools according to frequency or form of use. They pay an annual membership fee, for which they receive passwords to the system for designated staff members. Usage of the system is unlimited and users can call in from any micro—at school or at home.

The Hardware/Software Environment

The recent migration of multiuser operating systems to microcomputers, specifically XENIX and other implementations of AT&T's UNIX®, provided an inexpensive way of building a multiuser, multitasking host environment on PC-level machines. We started the service with eight por of a PC. We have since moved up to a PC AT-type host with twelve port and support for up to 2400-baud communication. In order to support the widest range of microcomputers, we assume no special intelligence of th computer terminal or terminal emulation software that dials into the syst We have found that many of our schools are using 40-column Apple and Commodore 64 computers, which limit the sophistication of the screen displays considerably.

Operating under XENIX, we use a commercially available videotex host application to handle end-user input, navigation, and directory structures. The application was originally developed to support touch-screen shopping kiosks using NAPLPS (North American Presentation Level Protocol Standard). While Learning Link remains a test-only service, we could add NAPLPS or Prestel graphics to the service (or a portion of it) if there were an application that justified the added editorial production costs and the purchase of the software or hardware decoders required by these graphic standards.

From this host application, we can execute any additional applications—such as mail utilities, a data base management system, or a text-editing system—that make information entry and management easier. These applications are written in C or UNIX shell scripts.

This environment is very different from that of traditional bulletin boards. It is "page-based" in that a user calls up one screen at a time. The pages are organized in a hierarchical, "tree-structured" file system. Each screen has a label at the top that tells the user where he or she is and how many pages there are at this level (such as 1 of 3). At the bottom of the screen are labels for commands to go to the next page, return to a previous page, or go up or down in the menu structure. The user's perception of the data structure matches the actual logical structure, and therefore it is extremely easy for even novice computer users to navigate around a large data base.

At points in the tree structure, the user finds a page that makes a call to an executable C program that provides access to true data base management programs or to applications such as mail or upload and download libraries. The shift to an application is usually invisible to the user, and the commands, look, and response of the application are designed to provide a seamless service. When finished with the application, the user is returned to the point in the tree where the shift occurred.

While this structure is useful for new users, it can be tedious for the more experienced, especially at 300 baud. The system supports an extensive number of keywords that allow users to jump to any specific point in the service immediately.

The system also has a range of tools that allow easy operation by the system operators and data entry personnel at the station. Most operations are selected from menus. Many of the operations are automated and performed on a regular basis by the system. For instance, we have automatic usage reports that allow us to track how frequently the service is used and compare the relative usage of the various sections. These are automatically generated after midnight on a daily and weekly basis by the system. The operators just print them out and distribute the reports, which we use to evaluate utilization of our content offerings.

Service Content

Learning Link currently has five main components: schedule and progra information, forums, gateways to on-line services, mail, and product and resource listings.

Schedule and Program Descriptions. The first section is up-to-date schedule and program information for all programming broadcast by Thirteen. This interactive TV guide takes information from a number of sources—PBS, program producers, press kits, and teacher guides—and provides content rewritten for use by teachers. Each description summariz a program and gives specific broadcast information. Users can browse o search by time, title, curriculum subject area, or grade level. The information helps teachers plan viewing or taping.

In addition, more extensive descriptions are available in a related data base file for each series that Thirteen broadcasts. These provide more detailed program descriptions at the series level, plus information on curriculum applications, recording individual program titles. This data base file can be searched with a variety of keywords also.

Forums. The purpose of a forum is to provide a place for teachers who share common professional concerns to communicate with each other on-line. The forums are subject specific; they focus on topics directly related to WNET programming as well as other topics of professional concern. While some forums are run by the WNET staff, we are encouraging teachers, curriculum experts, and professional organizations to mount and operate their own forums on Learning Link.

Some of the forums currently up on the system include *Square One TV* and *3-2-1 Contact*, both run by Children's Television Workshop; *Eyes on the Prize: America's Civil Rights Years, 1954–65*, run by a NYC public high school teacher who is a specialist in American history and political science; *Innovation*, the current events science program, run by WNET to supply secondary science teachers with background notes and strategies to use the series in their teaching; and a nutrition forum run by the Dairy Council to inform teachers of free or low-cost resources available to them and provide on-line access to nutrition experts.

Each forum contains some pages of information arranged in a menu-driven hierarchical tree. Although some forums have a great deal of information stored in this structure, the information tends to have a long shelf life.

Most forums also have a "message center," a form of the mail utility (described below) that allows users to post public messages or respond to previously posted information. These messages can communicate information to all users of that forum. Message length is up to the author of the message, and users can write with the simple editor provided or can "upload" messages that they have composed on their own word processors. Users can search stored messages by message number, date, sender, receiver, or subject. Upon entering a forum, users are informed of any new messages in the forum since they last checked.

Longer blocks of text can be stored in libraries of files for downloading. Entire teachers'guides, manuals, mailings, or lesson plans and worksheets can be stored in a forum library and selected for downloading to one's computer. Learning Link supports all popular file transfer protocols including ASCII, Kermit, X-Modem, and Z-Modem. Some forum libraries also allow users to upload files for distribution to others. The screen prompts and help features make file transfers easy to accomplish for all users regardless of their technical sophistication.

A forum can also link to relatively small flat-file data bases if relevant to the forum's content. This feature is useful for bibliographies, resource listings, and calendar-oriented information. Again, these files tend to remain static over long periods, since it takes some time and effort to build up the information.

Gateways. Our newest addition to the service is the capability to "gateway" to other services. A caller can choose a menu item on Learning Link and is automatically connected into a specialized remote data base. Before choosing to pass through the gateway itself, a user can review information on what is available, examine registration details (three of the four currently operating gateways are commercial services that charge fees for use), survey hints or lesson plans to help guide utilization, or use a message center for mail exchange regarding the gateway.

The gateway application program automatically dials the remote host and connects to it. Once at the doorstep to the gateway service, the user must log in, and from then on all data flowing between user and the new host is passed through Learning Link until the user exits out of the remote service.

One current gateway connects to New York City Board of Education's public access bulletin board, the Big Apple Board. We are working with the Board of Education and Teachers College on an in-depth study to learn how teachers and students use computer conferencing and on-line research tools. Teachers and students are using our other gateways to conduct research on selected topics. They then use the gateway to the Big Apple Board to discuss their findings, share problems and solutions, and reflect on the activity.

We currently gateway to Addison-Wesley's Einstein service, itself a gateway to almost 90 on-line information resources around the world. These data bases include full-text copies of international, national, and regional newspapers, the ERIC resource collection, the wire services, *Books in Print*, the *Readers' Guide to Periodical Literature*, the *Biographical Index*, the *Microcomputer Index*, and *AV-Online*. The service is menu driven and easy for novice researchers to use.

We also tie into Infosearch Scholastic Database, which features rapid full-text searching of encyclopedias and other reference works, as well as full transcripts of some of WNET's news and current affairs programming, such as *McNeil Lehrer Newshour, Currents, Adam Smith's Money World,* and *Nature*.

Our newest addition is McGraw-Hill's MIX service, which features a number of conferences on educational topics. MIX allows our users to connect to discussions with teachers or computer coordinators around the country.

The concept of providing gateways seems counter-intuitive at first. Why would someone go through Learning Link to these services instead of dialing in directly? Why do we want to tie up two of our phone lines for a single caller?

The reasons are straightforward: Our subscribers are often just beginning to explore the use of on-line resources. They are apprehensive about costs, and they want some support in the absence of guidelines or even well-documented teaching guides for many of these services. Learning Link helps identify services that are the most appropriate for school use and can provide exchanges for other users to accelerate the spread of information on how to utilize these services most effectively.

As our users gain sophistication and Learning Link becomes more refined, we will reduce costs to our subscribers and evolve the gateway concept to provide value-added services. These will include searching on Learning Link before connecting to the remote service (reducing vendor charges), connecting over high-speed modems and buffering the collected data back on Learning Link, or preparing a search strategy and downloading the strategy as a communications macro to work with the user's software on a directdial to the remote service.

Mail. Each user of Learning Link has a mailbox. Upon logging in, a user is told how many unread mail messages are waiting for him or her. The user can read these one by one or scroll through them in a continuous fashion that facilitates mail collection. The user can also read any previously read messages that have not yet been deleted from his or her box. After reading a message, the user can reply to it, delete it, or leave it in the mailbox. The mail system also enables a user to send a mail message to any other user on the system or to any of the forum message boxes.

Product and Resource Listings. In addition to our own data base of programming information, we have been searching for the best way to offer information about other instructional technologies and resources. Initially we evaluated an informational and transactional service called Best Buys. This service enabled subscribers to see information about selected software, hardware, and print products offered at substantial discounts. We had complete transactional capability so that with a purchase order number, a teacher could order any product and it would be shipped immediately.

While the idea appealed to many educators, we found that this service did not work well. First, WNET was not in a position to evaluate each and every product offered; we relied on evaluations published by other groups to select products for our catalog. This limited us to products that had been around long enough so that extensive evaluations were available. Our users wanted extensive listings, and they wanted information on new products.

Also, on-line ordering does not fit into the existing structures governing purchasing in most school districts. Actual purchases were rarely made; instead the information itself was considered the valuable aspect of the service. We are now revising this section.

We will mount catalogs for selected educational publishers and distributors who have extensive product listings that lend themselves to the advantages of a data base. The companies can gather leads of interested educators or, if they choose, can support direct transactions in their catalogs. However, WNET will not be directly involved in such transactions.

Another change involves moving the concept to other noncommercial resource listings. With the assistance of the Alliance for the Arts in New York City we are mounting a Culture Catalogue that lists museum resources and cultural organizations with services for schools. The Catalogue will cover permanent exhibits and performances, as well as those that change.

Formative Evaluation of Learning Link

We have received a grant from the Corporation for Public Broadcasting to evaluate the existing system, improve it where necessary, and test the feasibility of moving it to other public television stations. Our initial evaluations have centered on exactly who uses or could use Learning Link within the school context and what services they want that would foster regular utilization.

When one analyzes the school building in terms of telecommunications, some basic physical realities lead to hypotheses about who can use computer telecommunication and how they will use it. Because a user needs a microcomputer and a telephone line, the field narrows considerably. Teachers within classrooms are perhaps the least likely to be able to use such a service. In order to promote teacher use, access must be provided somewhere else in the building. Librarians, media coordinators, administrators, computer coordinators or teachers, curriculum specialists, and resource room teachers form a rough ranking of likely candidates, although teachers who have home computers also can use the service.

Indeed, our actual subscribers bear these hypotheses out. Librarians and media coordinators do form our largest group of subscribers, and they also represent the most frequent users of the service. They see it as their role within the school to promote information services, and the library in many schools is becoming the access facility to on-line resources. As we develop the service, we are trying to build resources that facilitate the role of the librarian/media coordinator as a resource for other staff members and students within the school.

A second area of development comes from the desire to make direct instructional activities for students available on Learning Link; we are extending the resources provided for the New York City research to all our schools. Our host software allows us to set up multiple services within the same host environment. The student service is kept separate from the professional service, but both are accessed in exactly the same manner. The users' log-in files direct them automatically to the appropriate service.

Finally, by using the type of low-cost terminals designed for home bank schools can provide teachers and students with terminals for use at hom in locations that have no computers. The terminals, usually priced unde $250, have built-in modems and can connect to regular television sets.

A different barrier to use arises around cost issues. We realized that ope ended billing was difficult for schools to deal with, but we underestima the difficulties caused by just the local toll charge. Many of our subscri call in from outside the immediate area code and are restricted in their u long-distance phone lines. In many cases, only district-level personnel h the authorization to use long distance on a regular basis. In our evaluatio most subscribers indicated that they would be willing to pay a reasonable surcharge for toll-free access, and they saw this as the single best way to build utilization of the service. We have recently installed an 800 number service for New York, New Jersey, and Connecticut, and we are seeing a dramatic rise in use.

We have also found that the user learning curve is quite short; new users soon want more sophisticated features. Downloading of files to facilitate local storage and printouts is being added based on user demand. And while many of our users still have 40-column equipment, these formats are annoying to those with 80-column capability, especially in the messaging and information screens. We are now moving to variable-width formatting.

Within the forums, we have found that the role of forum manager is the key to the activity of the forum. The best forums have a core group of people who use them on a regular basis. Having a specific project or goal helps focus the forum. Open-ended forums, especially those with a philosophical bent, are not used. We have also found that many users have difficulty using the same utility to post and review public messages and send or read private mail. We are working on new structures that make this activity more intuitive. Another strong request by forum managers is for an easy-to-use survey tool to adapt to forums. Whether used for polling or for information gathering, this type of utility would add significantly to many forums.

Structurally, we have found that users prefer broad menus with many options rather than a deep menu structure with few options at each node. This matches findings from other research. While a bit more intimidating for new users, the broad menu is far less tedious over time. Even with our very extensive menu structure, we find relatively little use of keywords to speed navigation. The broader menu structure apparently serves to prompt users on choices available and still provides a structural scheme to the data base.

Finally, we are evaluating the question of critical mass: What is the correct balance between a depth and diversity of information that will attract and keep people using Learning Link, and a clearly focused service that is not struggling with the impossible mission of being all things to all people?

Answers to this critical question will emerge over time. The key is providing information and tools that meet real needs of educators. The benefits from use of an on-line service must be immediately apparent and quite tangible if the service hopes to attract more than a small percentage of potential users. While our program information is the driving force for our involvement in on-line services, the forums, gateways, and resource data bases are attempts to develop a successful content mix that attracts and sustains regular use.

Extending Learning Link to Other Sites

WNET's experience, and the specific system components it has d[illegible]elop[illegible] can benefit other stations eager to enhance educational or viewer servic[illegible] through the use of interactive systems. Given the cost of developing suc[illegible] systems from scratch, the limited funds available for such purposes, and [illegible] benefits of having a network of stations using similar protocols, this sy[illegible] has widespread utility and value to additional markets beyond the New[illegible] metropolitan area.

We are proposing a partnership of stations interested in using locally adapted and operated systems based on Learning Link or similar system[illegible] Each operation would be independent and managed to suit the support[illegible] services currently offered by the various stations. Some services would b[illegible] centrally provided to all partners: program data bases, editing tools needed to adapt or modify the data bases to local schedules, installation and training, technical support, marketing materials, and hardware and softwar[illegible] licensing.

The system can be shrunk or expanded according to need. Attaching fewer modems and phone lines lowers the operating cost until volume requires the additional ports. The system has provisions for running multiple hosts (linked PC ATs or PCs) if demand exceeds the capacity of 12 to 16 lines. In this way, each system can grow in modular fashion as the market grows and develops without facing large capital expenses.

The data bases formed on one Learning Link system can be moved to another system and run as is or modified to suit local needs. Given the nature of the system software, it is relatively easy to provide technical support remotely, with service available by having a centrally located support person dial in to the system and evaluate the problem or program a fix.

This model, in direct contrast to large, centrally operated and administered data base services, is based on the emerging power of microcomputers to provide services formerly found only on minis or mainframes. The model provides several advantages to public television stations:

- It preserves the independent control of local services and the ability to react and adapt to local needs.
- It provides for the diversity of services, administrative systems, and financial situations found at public television stations.
- It is economically feasible for most stations to capitalize such a system, given the low cost of the components, and to operate a service using existing personnel.
- It allows for resource sharing and central development, where it makes sense, so that each station doesn't have to duplicate efforts or expertise.

The model, while unique in some respects within the on-line data base world, is not an unusual model for public television stations. It is a simplified extension of the basic public television system for program development and distribution to the newer realm of computer-based telecommunications. For public television stations, the model creates a service niche that lies between the small, grass roots bulletin boards that have proliferated across the country, and the specialized on-line data bases serving a national or international audience, but too expensive for local educational support.

Robert Spielvogel

Robert Spielvogel, currently the director of Learning Link, was responsible for the original design and implementation of the system. Before beginning his work on Learning Link, he worked on a variety of projects for the on-line and videotex industry, specializing in educational, training, and user interface applications. Mr. Spielvogel's background includes work as a classroom teacher, elementary school principal, and graduate researcher in the field of educational psychology.